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A SOCIETY FOR THE ADVANCEMENT

OF THE

SCIENCE OF ELECTROPLATING

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TO OFFICERS AND MEMBERS OF ALL BRANCHES

The Publishing Committee of 1927 and 1928 after receiving answers to all questionnaires sent out by the Chairman, Mr. Hogaboom, have recommended that the Society Question Box become a part of our Monthly Review and the editorial staff now ask you to forward questions, to be answered in succeeding numbers, or as soon as the best possible answer can be obtained by investigation.

Each question will be numbered and tabulated and answer likewise that references may be had to them in emergencies. **EDITOR.**

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EDITORIAL

PRESIDENT'S MESSAGE

To the Officers, Members of Branch Societies and Delegates to Our Annual Meeting at Toronto: I wish to express my sincere appreciation for the honor you have conferred upon me, and as your president during 1928 and 1929 I shall endeavor to merit your confidence and further extend the progress of our society and its ideals.

I also wish at this time to express a wish that all our members assist their respective branch officers this year as much as possible by their attendance at meetings, interest in the topics being discussed and help the executive officers of this year to be extremely happy in reporting at Detroit, Mich.—next annual meeting—that this was the most progressive year in the annals of our society.

In conclusion, I desire to call your attention to our Research Fund, More contributions mean more research, lots of questions mean more information, so do not neglect the Society Question Box, and last but not least, more members, more interest and attention mean a greater society and more pleasure and profit for its members. Sincerely yours,

HORACE H. SMITH, President.

Message from President's Smith's Office, Newark, N. J.

The following Committees have been appointed to act, 1928-1929, by President H. H. Smith:

Research: R. J. O'Connor, Bridgeport Branch, Chairman; P. Sievering, Newark Branch, Treasurer; J. Sterling, New York Branch; W. S. Burrows, Toronto Branch; S. E. Hedden, Pittsburgh Branch; W. Jordon, Hartford-Connecticut Valley Branch.

Prize Award Committee on Papers, 1928-1929: Oliver Sizelove, Newark Branch, Chairman; Geo. B. Hogaboom, Newark Branch; Dr. Wm. Blum, Baltimore-Washington Branch; S. P. Gartland, Rochester Branch; H. Terdoest, Cleveland Branch; Dr. Kent Graham, Philadelphia Branch.

I have also asked Messrs. W. Fraine, Dayton; Geo. B. Hogaboom, Newark; H. H. Williams of St. Louis branches to assist Secretary-Treasurer Gehling to bring the Constitution and By-Laws up to date that new issue may be printed at early date.

Attest: HORACE H. SMITH, President.

PHILADELPHIA BRANCH MEETING

Extract, Quaker City Reminder

The regular monthly meeting was held on May 4 with President Gehling presiding.

The meeting was now turned over to the Educational Committee, who introduced Dr. William Blum as the guest speaker, and his subject, "Acid Copper Plating."

Dr. Blum: When your chairman asked me to speak on acid copper solutions, I accepted with some hesitancy because acid copper solutions are rather old and well known. As a matter of fact, we have not done much work on them recently, and have very little that is new or interesting to give you. Yet, on thinking over the subject, I felt it might be well worth while, for several reasons, to take a little of your time in discussing this subject. In the first place, the acid copper bath is about the oldest bath that has been used for electroplating. In the second place, if we include the electrolytic refining of copper, it is the bath which is used to a far greater extent at the present time than any other bath for depositing metals. There are millions of pounds of copper deposited every day in the acid copper bath. Then, again, the acid copper bath is used invariably in connection with the electrotyping, the sister industry to electroplating, and an industry with which we have also been in close contact. And then, finally,

within recent years, the interest of platers in the acid copper bath has probably increased.

A few years ago, the acid copper bath was used mostly in connection with ornamental work, such as slush castings of antimonial lead, where it was desired to get an oxidized finish. As you all know, it is not possible to deposit from the acid copper bath directly upon iron and steel, and so the cyanide copper bath was used more extensively by platers.

With the development of thick nickel deposits for protection against corrosion, e. g., in the automobile industry, the acid copper bath is being used quite extensively for producing an intermediate coating between two layers of nickel. Hence, there are probably more plants doing acid copper plating today than there were five or ten years ago.

Another very good reason for discussing the acid copper bath is that there has probably been more research work done upon that bath than upon all other plating baths together. Everybody that starts out to study elecro-deposition makes some experiments with acid copper solutions; and so we find a very large amount of literature published on this subject. In spite of that fact, I say, without hesitancy, that the bath is not well or fully understood at the present. We ordinarily think of the acid copper bath as a "fool-proof" bath. It is. It is probably easier to get fairly good deposits of copper out of an acid copper bath than from any other plating bath that we have, because the conditions, such as composition, temperature and current density can vary very widely, and still yield passable deposits.

The operation and study of the acid copper bath serves as a very good illustration of the principles of electroplating which apply to all baths. And so, tonight, in discussing this bath, I am going to use it largely by way of illustration; to show how, by means of the acid copper bath, we can explain many of the effects that are encountered in other plating baths as well.

In considering just what we had on this subject, I found that at the Bureau we had done a great deal of work on the copper electrotyping solutions about fifteen years ago. The first work that we did when I became interested in this field at the Bureau was on acid copper baths; in fact, most of these cards and some of the slides which I will show you, were made in connection with that investigation. The first talk that I ever gave to any group of electroplaters was on acid copper baths at the New York Branch

banquet in 1916. Since then we have not made any consistent study of this bath. We have, however, made incidental observations upon it, when we have studied throwing power, polarization and addition agents. Just within the last six months, Mr. Hull, who is a Research Associate, employed by the Electrotypers' Association, is starting another study of the acid copper bath in order to determine just what benefits can be obtained by the use of addition agents, particularly in using very high current densities. While his work is not far enough along to warrant any definite recommendations, I did bring one card showing some of the samples of his work, which indicates the possibilities in that field.

Composition among the various factors involved in the acid copper bath, we may consider first; the composition of the solution. Just two constituents are essential to this bath, namely, copper sulphate and sulphuric acid. Just why is copper sulphate used instead of other salts that might be used? In the first place, it is cheap. In the second place, it is quite soluble in water, so that you can have a fairly high concentration; and, in general, the more of the metal salt that is dissolved in the solution, the higher the current density that can be used without burning the deposit. In the third place, it is a stable salt, that is, it does not easily decompose. If we used copper nitrate, for example, the nitrate would be reduced by electrolysis so that the composition of the solution would change rapidly. Copper chloride is a more difficult salt to handle because of the fact that it readily forms the two salts, cupric chloride and cuprous chloride, the latter of which is nearly insoluble.

If you attempt to pass a current through a solution of copper sulphate alone, you will find it difficult to get a good deposit at any reasonable current density. For various reasons, sulphuric acid is always added to a copper bath; in fact, it is a very good illustration of how the right substance may accomplish several purposes. The most marked effect of sulphuric acid is to increase the conductivity of the solution. In addition, it decreases the tendency of the copper sulphate to decompose, or, as the chemists would say, to hydrolyze and, hence, you can use higher current densities without the deposit burning, or without having trouble with coating of the anode. It also increases the anode corrosion. It decreases the copper iron concentration and increases the polarization somewhat, and, therefore, produces finer grained deposits. It increases the throwing power and it reduces the treeing. You

can see from all those effects that sulphuric acid is a mighty good thing to have in an acid copper bath.

If copper sulphate and sulphuric acid are both desirable, why not add as much of each as you can? There is one very practical difficulty, that the addition of sulphuric acid to a copper sulphate solution decreases the solubility of the copper sulphate. You can have a certain amount of copper sulphate present in a solution, in water, say roughly about 48 ounces per gallon of copper sulphate. As soon as you add sulphuric acid to that bath, you decrease the amount of copper sulphate that will stay in the solution. When saturated at ordinary temperature the sum of the two is about 48 ounces per gallon. Thus, if you add sixteen ounces per gallon of sulphuric acid, you can dissolve only about 32 ounces of copper sulphate. Practically the sum of the two should usually not be over 42 ounces per gallon, because if you have more than that copper sulphate will crystallize out if the solution evaporates or gets very cool. In electrotyping it is customary to have about six to ten ounces per gallon of sulphuric acid and 32 to 36 ounces per gallon of copper sulphate. In electroplating only about 4 ounces per gallon of sulphuric acid is generally used.

Addition Agents

A great many materials have been proposed as addition agents in copper baths. It is no exaggeration to say that at least 100 have been suggested or tried at one time or another. The purpose of addition agents in acid copper solutions in general is to produce smoother deposits or to prevent burning of the deposits, and thereby permit higher current densities to be used. The current density that can be used ordinarily in a copper bath may be limited by either the burning or the treeing of the deposit. In general, as you increase the current density, there is a tendency in any given solution to get a "burnt," rough, red structure. The practical limit to the current density that can be used for example in electrotyping is usually the treeing of the deposit in the form of rough nodules, especially on the edges and the corners.

Addition agents, in copper solutions, have as their principal purpose the production of smoother deposits of copper. In electrotyping a little roughness does not make much difference, because in making an electrotype on a graphiteed wax mold, that part that is deposited last is the back of the shell, over which type metal is poured. But in electroplating a book end or something of that sort with a heavy coating of copper, you would not want

trees or lumps on the surface, because when buffed they would break out and leave a very poor deposit. So in copper plating from this bath it is usually necessary to use much lower current densities than are used in electrotyping. In electrotyping, it is customary to use up to 100 amperes per square foot, whereas, in copper plating not over twenty to thirty amperes per square foot is used.

Addition agents of all kinds have been suggested. The one that is most common in such baths is glue. Practically all copper refineries use a very small amount of glue in the bath, about two parts per million, or one part in 500,000. That is a very small amount, but it is sufficient to make the deposit smoother and to reduce the treeing and the formation of nodules. Other substances that have been used are alcohol, phenol, cresol and other proteins similar to glue, such as albumen and casein. There is one very serious objection to the use of addition agents, and that is the fact that they have to be employed in rather small amounts, and they are rather difficult to control by analysis. Too much of an addition agent is usually worse than none at all, as then the copper gets very hard and brittle and is likely to crack.

Conductivity

The properties of the bath will determine how the bath will actually work in practice. The conductivity of a good acid copper bath is the best of any of the common plating baths. A good acid copper bath has a resistivity of 3 to 5 ohm-centimeters. You need not worry about the exact value of an ohm-centimeter. It is the unit of resistance of a cube that is one centimeter (four-tenths of an inch) on a side. For our purposes only the relative values are of interest. If a solution has a low resistivity, it has a good conductivity. An ordinary nickel plating bath has a resistivity of about 20; that is, four or five times the resistivity of this acid copper bath. We can reduce the resistivity of a nickel bath to as low as 8 ohm-centimeters by adding sodium sulphate. The ordinary zinc sulphate bath used for plating has a resistivity of about 20. We can use zinc chloride plus a large amount of sodium chloride and bring that resistivity down to anywhere from 3 to 8; that is, we can make its conductivity nearly as good as that of an acid copper bath. A chromium bath has a low resistivity, usually about 2 to 3 ohm-centimeters. It is, therefore, really a better conductor than most of the acid copper baths. The reasons that you have to use a higher voltage in the chromium bath

are first, because you have more polarization, and, second, you usually use a high current density in chromium plating. A practical illustration of the good conductivity of an acid copper bath is that an electrotyper will very commonly hook two baths in series, and with a six-volt generator get 50 amperes per square foot.

Polarization

By polarization at the cathode, for example, we mean the actual voltage that is used to deposit the metal. The total voltage between the anode and cathode is due to (1) the voltage of the anode polarization; (2) the resistance of the solution, and (3) the cathode polarization. These three together make up the total voltage that is needed in order to make the current pass through the solution. In the acid copper bath, both the anode polarization and the cathode polarization are lower than in most other baths. The copper bath has a poorer throwing power than most baths, because the cathode polarization is low.

(Slides were then used to illustrate many of the factors.)

In a copper bath the polarization curve slopes but little; that is, as you increase the current density rate of deposition, it does not take a much higher potential to cause the metal to deposit than at a low current density. In a lead bath the curve is almost exactly straight; that is, there is almost no polarization. A zinc sulphate bath has about the same curve as the acid copper bath. But the cyanide copper bath has a curve that is very much more sloped, which shows there is much more increase in polarization as we increase the current density.

If we take an ordinary acid copper bath, we find it has a certain polarization represented by a line which we call a standard, simply for the purpose of comparison. If now we add copper sulphate to that solution, we decrease the polarization; that is, we make the curve more vertical. We can understand that if we consider why there is any polarization at the cathode. When we deposit metal at the cathode we are taking metal out of the solution. Therefore, just at that instant here cannot be as much metal in the solution as there was before, until more metal comes up to take the place of that solution that is right next to the cathode. This "cathode film" is a little weaker than the rest of the solution, and, in consequence, it means that it takes a little higher voltage to keep on depositing metal out of a weak solution than it does out of a strong solution. If we add more copper sulphate to the solution, it means we are putting more copper in there, and,

consequently, it does not get weak so readily when we pass the current through it; that is, we decrease the polarization. Summarily, if we agitate the solution we bring up more copper to the face of the cathode; in other words, we replenish it more quickly than if we just waited for it to come there of itself. So when we agitate the solution we have less polarization. If we warm the solution to 45° C. (113° F.), we find also that we have less polarization; the copper ions travel more rapidly because there is more rapid diffusion. On the other hand, if we add addition agents such as gelatin, dextrin or aluminum sulphate, we increase the polarization. The reason that occurs is that gelatine, as you know, tends to make the solution more viscous and keeps the solution from moving so freely as it would otherwise. In passing the current through a solution containing even a small amount of gelatin, the gelatin travels to the cathode, where it tends to accumulate on the cathode surface, and even to deposit with the metal. If the gelatin travels to the cathode, then at the cathode surface it is a little more difficult for the solution to move over the surface and, in consequence, it increases the polarization.

Dextrin is present in corn, syrup, such as "Karo," which consists principally of a solution of glucose or dextrose. Dextrin is a colloid and, like gelatin, it increases the cathode polarization.

If we add two parts per million of glue to a copper solution we get a very appreciable increase in polarization; and with ten parts per million, a greater increase.

As I said before, one of the objections to the use of addition agents is that it is hard to make an analysis and find how much is present. By this method of measuring polarization it is possible to tell the amount of gelatin that is present in the solution. Copper refineries are using this method now, with a simple box for measuring polarization to enable them to tell how much glue they have in the solution, and when they need to add more.

The throwing power depends a great deal on the cathode polarization. If you have no cathode polarization, you have practically no throwing power, and, as a rule, the more cathode polarization you have, the better the throwing power. The fact that cyanide copper solutions have a very much higher cathode polarization is consistent with the fact which all of you know, that the cyanide copper bath has a much better throwing power than an acid copper bath.

Let us see some of the actual results obtained by measuring

the throwing power of acid copper solutions. We measure throwing power in a box in which we have two cathodes; one of which is five times as far away from the gauze anode as the other one. Under those conditions we would expect to get five times as much metal on that near cathode as on the far cathode. Actually, however, if we have any good throwing power in the solution, we may do better than that; that is, we may plate the two more uniformly. Suppose, for example, we get only four times as much on the near plate as on the far plate. Then we have made an improvement of 20 per cent in the throwing power; that is, we have made it 20 per cent more nearly uniform than it was to start with. The per cent of throwing power is simply the change we make in the ratio of deposit on the near plate and the far plate. In this acid copper solution under typical conditions the throwing power is only about 10 per cent. As we increase the current density, we decrease the throwing power. That means that if we deposit rapidly on an article we get more metal on, but it is less uniformly distributed. Similarly if we warm or agitate the solution, we decrease the throwing power down almost to zero. It happens that both of these conditions, and also the addition of copper sulphate are conditions that are favorable for the use of higher current densities. We must therefore take the choice between depositing metal faster, even though it is less uniform, or getting more uniform deposition more slowly. "You can't have the penny and the cake both." By increasing the amount of sulphuric acid in the solution, we increase the throwing power slightly. If we add addition agents, such as dextrin and gelatin, we nearly double the throwing power. That ties up with the fact that I told you a minute ago, that these addition agents increase the cathode polarization.

In the acid copper bath the throwing power is usually about 9 per cent or 10 per cent., and it is very difficult to increase it even as much as 18 per cent, whereas in the cyanide copper bath the throwing power is 30 per cent to 40 per cent, which agrees with experience.

The structure of the copper is important because, after all, you are not depositing copper for the sake of depositing it; you are depositing it in order to cover something or to produce a coating with certain properties. For some purposes it must be soft and reasonably smooth, for others, it must be hard.

The thing that determines whether a deposit is satisfactory for

certain purposes is the structure of the deposit. All electrolytically deposited metals are made up of crystals; and if we study the crystals of the deposit, we can tell to some extent at least what the properties of the metal will be, whether it will be hard or soft, brittle or ductile. In general, we can say that the finer grained the deposits are, the harder they are. If you want a soft copper that will buff to a nice finish, you want to produce rather coarse crystals of copper. We must distinguish between the crystals of copper and the surface. We may make a deposit which consists of very fine crystals, and yet the surface may be rough and have trees on it. Those trees are not large crystals; they are simply lumps made up of small crystals, which form because of the conditions such as high current density, that favor treeing. This slide diagrammatically shows all the different kinds of crystals we can have. There are (1) little separate cubes; (2) needles that stretch out from the cathode; (3) columnar crystals alongside each other; (4) fibrous crystals alongside each other; (5) crystals that spread out in the shape of a fan or cone, and as they get larger, they crowd out some of these other crystals; (6) we may have crystals which we show diagrammatically by cross lines, which are called "twin crystals" that are partly of one crystal structure and partly of another; just as if two crystals got together and got mixed; and then we have (7) this broken structure, where the crystals are of all shapes and sizes; or, we get (8) aboreal or treed deposits. Finally (9) we have powdery deposits. In general, as we increase the cathode polarization by increasing the current density or any other means, we tend to change successively from one to the other of these types, all of which, to some extent at least, may be illustrated with copper deposits.

The relation between the structure and the conditions of deposition is shown in the figures. As we increase the current density up to a certain point, the deposit gets finer. The crystals at a low current density are coarser than at the high current density, but as soon as we get up to about 30 amperes per square foot in a still, cold solution, we get a deposit that is spongy.

A deposit made at a low current density is very soft and has a low tensile strength; but it might be the kind of deposit a plater would want because it would polish more easily. The electrotyper wants to make a printing plate that will last on a press, and will use a harder deposit produced at a higher current density.

Increasing the temperature always produces coarser grained and softer deposits. This is true also with nickel and most other metals. We found in studying electrotyping solutions that a difference in temperature of from 75 to 115 degrees Fahrenheit, such as may occur in a day if the solution has much current passing through it, made a big difference in the properties of the deposit, bigger than any other factor in electrotyping. If you wish to get a uniform deposit of copper, you must control the temperature as well as the current density.

If we have a low concentration of solution, for example, one containing about one pound per gallon of copper sulphate—we get marked improvement in the deposit by means of agitation, with air or by stirring. If, however, we use a higher concentration of copper sulphate and the same current density, the agitation does not have so much effect because we have not reached the current density that starts to produce a burned deposit with the higher amount of copper present in the solution. Electrotypers almost always use air agitation as it is the simplest way of getting agitation where you want it, especially between large plates such as they have.

Sulphuric acid up to a certain content reduces the treeing and the burning. You can see in each case we have a solution with a small amount of sulphuric acid and then a larger amount, and you can see how much smoother the deposit is after adding the sulphuric acid. Mr. Hull, in his recent experiments, has found that if you go too high with the sulphuric acid you tend to increase the burning and treeing, because as you increase the sulphuric acid very much you have to decrease the copper sulphate.

Sodium sulphate in a copper sulphate solution has a slight effect in producing a smoother, finer grain. A cyanide copper deposit has a much finer grain than a copper sulphate deposit. We can make a very much greater difference by adding addition agents. A small amount of glue makes the deposit very smooth and like a mirror. Glucose has a similar effect, but not nearly as great as we get with the glue.

In addition to these slides I want to take just a minute to call attention to these cards as I pass them around. These deposits are all about six thousandths of an inch thick, which, of course, is a great deal more than an electroplater would be accustomed to deposit. These are about the thickness of an electrotype shell,

and illustrate the effect of the temperature, current density, copper sulphate, etc. As I told you, Mr. Hull is now working on the problem of depositing copper more rapidly in electrotyping, for example, by the use of addition agents. A lot of addition agents have been used as secret solutions, and we want to find out whether there is much to be gained by it.

It takes about 20 ampere hours per square foot to deposit a thousandth of an inch of copper. If you deposit at the rate of 20 amperes per square foot, you will deposit a thousandth of an inch in an hour. If you deposit at 100 amperes per square foot, you will get five thousandths of an inch per hour. Actually, most electrotypers are using around 60 or 70 amperes per square foot, and require one and one-half to two hours to deposit a shell that is six thousandths of an inch thick. In the experiments which Mr. Hull is working on, and which are by no means completed, he started out to find out what can be done without addition agents, and then see just what improvement can be effected by means of addition agents. These few samples that I have are all made at a current density of 280 amperes per square foot, which, you see, is much more rapid than the platers are accustomed to use. In order to do that we had to have very good air agitation, uniform over the whole surface. The first three had no addition agent, they were simply produced with the copper sulphate and sulphuric acid. While they are pretty good copper they are all somewhat sandy. This one which had glue in the solution (about 50 parts per million, which is a good deal more than is used in copper refining) has a surface that is smooth and silky as compared with the sandy structure on the others.

We are not prepared to say certainly at this time that an electrotyper will be able, as a regular practice, to deposit at 300 amperes per square foot, but we know it has been done. If he can deposit at 300 amperes per square foot, it would mean that he could make a deposit of six thousandths of an inch in about 20 to 25 minutes; a big saving over an hour and a half to two hours; especially when it is necessary to rush the work through. These deposits were made in warm solutions, about 45 degrees Centigrade, or 113 degrees Fahrenheit, which is about as warm as can be used without melting the wax the electrotyper uses; and they were very well agitated. In the bath with the lowest amount of sulphuric acid it was very difficult to get that high a current density without the anode getting coated. Especially at a lower

temperature it required twenty or twenty-two volts to get that current density because the anode got coated over. That was a case of high anode polarization; but by warming the solution and adding more sulphuric acid that difficulty could be largely overcome.

From this sketchy talk you can see that while there are lots of things we know about acid copper solutions there are lots more things that are not known, and among other things we hope during the next year to finish this work on addition agents so we will be able to tell just what addition agents can be used to give the most rapid deposition and most satisfactory conditions.

Question: I had experience plating a disc wheel in an acid copper solution, and I tried to use 20 amperes per square foot, and that disc wheel contained about four square feet and then there was a portion on there that was absolutely no deposit of copper on.

Dr. Blum: What was the metal?

Question: Steel. Nickel plated one hour and then trying to put acid copper on that. It was about 24 inches in diameter.

Dr. Blum: Was that part that got no copper further away from the anode—in other words, was it a question of throwing power?

Question: It was further away from the anode because in the bath, I had to turn the thing upside down and really there was no anode underneath it, it was facing the bottom.

Dr. Blum: Yes. It was probably just a case of poor throwing power. You might have been able to lay some anodes on the bottom of the tank.

Question: I didn't think of that; I could have done it.

Question: On one of those slides which you showed, there were a few blurs where it had been plated at about 75 amperes, I think. Wasn't that a sort of blister in the plate?

Dr. Blum: It is possible that it might have been blistered although it is more likely burnt. We are depositing copper on copper, and had no trouble getting it to stick. You might have cases where you are depositing copper on nickel or something like that where there might be a tendency to blister, but I don't think that would be true in the experiments we were carrying on.

Question: What made me ask was the work I am on are largely rolls for rotogravure work, and we sent about ten of them to a certain place in Philadelphia to be deposited. They were done about twice as fast as I could, but when we received the rolls back we had to turn all that copper off. Most all the ten rolls we had to turn about three-quarters of an inch off. We plated them an inch and a quarter, but all the way through the deposit had blurs the same as the slide shows, and they claimed they were doing great work depositing so many pounds an hour more than I could do, and this and that, but their plate was no good.

Dr. Blum: It is probably porous.

Question: Yes, porous and little blisters and crumbly.

Dr. Blum: That is one of the difficulties as soon as you try to deposit at too high current densities. Do you know what current density they were using?

Question: No, I don't know; that is, I thought they were doing it about three or four times faster than I was.

Dr. Blum: How fast do you find it feasible?

Question: I plate with 35 amperes per square foot, or as low as 25 to 30, sometimes, on a rotating cylinder and receive a very fine structural copper, hard enough for the etchers to etch and engrave on, and very well satisfied with it. It stands up good under the press. The others would not; they were too soft and they had all kinds of trouble until I replated them.

Dr. Blum: Was the current density 25 to 30 amperes per square foot on the part that was in the solution?

Question: Yes. The cylinders are 43 inches in circumference and 7 feet long, with 12 inches in the solution.

Dr. Blum: I would say that under ordinary conditions 25 or 30 amperes per square foot may be as high as you can go. I believe if you can rotate a cylinder more rapidly, and have the best concentration of copper sulphate and sulphuric acid, and especially keep your solution filtered so there is no sludge or dirt from the copper anodes; you might be able to double it easily and still get a good smooth copper. Of course, the thicker you deposit, the more rough it tends to get. Anybody can make a smooth, thin deposit like the ones I showed here, a few thousandths of an inch thick, but an inch thick is another matter.

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

Mr. H. E. Willmore, Associate Editor of Review and member of Chicago Branch, is convalescing at Elkhart, Ind., after a serious illness and operation.

Chas. Weston, also of Chicago Branch, is out of hospital and hitting high spots again.

By Sir Jas. Irvine, University of St. Andrews, Scotland—

"Chemistry is the nemesis of monopoly based on raw materials," the Scottish scientist said. He has had a great deal of experience as a governmental and political counselor. "By reducing many forms of matter to simple elements or compounds and then fabricating by synthesis a desired substance, chemistry works for equal industrial and commercial opportunity. It is the foe of monopoly public or private. The free interchange of scientific knowledge and theory makes it so."—*Chicago Daily News.*

Aluminum Plate Method Is Found—

Illinois Chemist Devises Means; Discovery of Great Value—

Aluminum, heretofore though impossible to electroplate, has been successfully put through that process by Prof. D. B. Keyes and assistants in the chemistry laboratories of the University of Illinois, it was announced today at the American Chemical Society Institute.

So far as known this is the first process of plating aluminum to other metals ever devised. Its importance to industry is regarded as tremendous.

"Pure aluminum will resist ordinary atmospheric corrosion and has high resistance against such concentrated acids as nitric, acetic, and sulphuric," Prof. Keyes said. "But unfortunately, pure aluminum has a low tensile strength, and, what is worse, a low elasticity. It is, therefore, unsatisfactory as a structural material.

"However, it is apparent that if it was possible to electroplate aluminum on steel or common metals, the resulting material would be extremely useful for many purposes.

Lists Valuable Savings

"To illustrate a few of the possible uses, one might mention aluminum-plated

steel economizer tubes. These tubes contain water inside and hot flue gases on the outside. The flue gases, especially those used in the middle west, contain large amounts of corrosive sulphur compounds due to the high sulphur content of the coal in this territory. Aluminum electroplating on the outside of these tubes should save a vast sum of money, which is now spent for replacements.

"Another interesting case is the tubes and reaction chambers used in cracking stills. These are corroded due to the sulphur compounds in the oil. An aluminum plate inside these tubes would eliminate this difficulty.

"The smokestacks on ordinary locomotives are corroded by the sulphur fumes. An aluminum plate inside these stacks would undoubtedly solve the problem.

"It is impossible today to store compressed gases in an iron cylinder and have them remain pure. Volatile impurities are formed by chemical action with the iron. An aluminum plate on the inside of these steel cylinders probably would do much to keep these gases pure.

Save Kitchen Pots

"An aluminum plated iron cooking utensil would be far superior to the modern solid aluminum product. There also are many pieces of common chemical equipment which, if plated with aluminum, would stay in service for a much longer period.

"In brief, aluminum-plated steel would mean a material of high tensile strength, great elasticity and resistance to corrosion—a material that all industries would find useful."

It is believed that the general type of electroplating used in the Illini chemistry laboratory eventually will solve the problem, not only of electroplating aluminum, but also of electroplating many other metals, which were thought to be impossible to deposit as an electroplate.

It is probable that the substitution of this method for the common water solution method will mean in certain cases an increase in efficiency of operation and the production of a superior plate.

In order to develop these ideas the investigators will attempt electroplating of titanium, tungsten and iron.—*Chicago Daily News.*

Quite Safe—

"Will my boy learn to drink at your school?"

Professor: "Sorry sir, but we can hardly find enough for the faculty."

The man who gives in when he is wrong is wise but the man who gives in when he is right is married.

PHILADELPHIA BRANCH
MEETING OF APRIL 6, 1928

Meeting was called to order by President Gehling and all officers reported present. After the regular business of the meeting was disposed of the meeting was turned over to the Educational Committee, who introduced the guest speaker of the evening, Mr. Robert McLatchie of Pottstown, Pa., and gave a talk on "My Experience in Nickel Plating Die Castings."

Mr. Robert R. McLatchie of Pottstown, Pa.:

I don't know that I have anything that will be of any benefit to you or not, and, as a matter of fact, I am not responsible for my being here tonight. There is Hank Robinson up there and Bill Scott over here, who have been telling me for some time that I have something that would be of interest to the electroplaters, and have been asking me to come down here and tell them my experience in Pottstown on plating die castings.

I won't attempt to tell anybody how to nickel plate, I can only tell how we do it up there, and, after that, it will be up to them. If they get anything from my remarks, I will be very glad, but from an educational standpoint, or from the standpoint of a chemist, I am afraid I would flounder, so that I can only give you just what method we use up there in plating die castings.

Our work is about 99 per cent die castings. I think I am safe in saying that. We have about as a rule from four to six polishers, and two to three in the plating room; usually about three. It is all die castings. When we get anything in bulk, other than die castings, we find that it interferes with the plating of the die castings, which I believe some of you men might find in the jobbing business. When you get a couple of pieces of die casting work to plate in with your other stuff, you have trouble for the reason that you are not prepared for it, whereas, up there we had to prepare for die castings and forget about the other stuff.

In the first place, when we get this stuff in, it depends on whether or not it is a good sized casting as to how we proceed with it. If it is a small casting, as a usual thing we get away with it by cutting down on the rag wheel and nickel plating. If it is a rather large casting, we find that the die casting plants are not so successful in getting a smooth casting when they make the smaller castings. And for that reason, we have to grease those out, and for that operation we never use anything heavier than 150 grain emery, and felt or canvas wheel with grease. After it is cut down, of course, we use the regular procedure in

preparing it for nickel plating, put in down on a loose buff, and we try to get a good grade of tripoli. I think that it is necessary that you do use a good grade of tripoli for this work, for the reason you can't let it in your cleaning solution very long. If you do, it will oxidize and your troubles begin.

Now, when we get the stuff cut down and ready for plating—there was a time when we used gasoline to cut the polishing compound and make it more easily cleaned. We did that for the reason that, like those other plants, when they started on die castings, they had a lot of trouble, and we did that to get it as near chemically clean as we can before putting it in our cleaning solution. But, however, the last few years, we have found that that wasn't really necessary. We got to a point where we could have our cleaning solution so that we could clean it without the use of gasoline or any other substance, particularly on plain work.

Now, in preparing our cleaning solution, we use about two ounces of cleaner to the gallon of hot water, and I would say that the water should be about 180 degrees. I won't hold it right to exactly 180 degrees; it might vary from 170 to 190, but we find if we get it much hotter than that, there is trouble, and, of course, if it is much cooler than 170 degrees, it doesn't do the work.

We use an electric cleaner, of course, and in that way do away with a lot of scrubbing, but there is some of this work which we scrub, and we have to handle it quickly, or, as I said before, it will oxidize. But, for the most part, we get this cleaned work through without scrubbing, and then give it the regular rinse in cold water and a muriatic dip about, I will say, 3 per cent acid.

Now, when I hesitate on the amounts, it is for this reason: We do everything up there by observation. We haven't, nor have we ever had, any instruments for measuring. It is probably a crude method, but we have been doing it for five years or more, and we have been getting results. And when I say that we use a 3 per cent dip, I am pretty close to it, from the experience we have had.

Now about the preparation of the nickel solution, we use an ordinary nickel solution, with the addition of about twelve ounces of sodium sulphate, which, I believe, cuts down the acid content of the bath, and from what I can see from my experience, I would say that it protects the metal until such time that it gets a film of nickel, after which, of course, there isn't any trouble.

Now, when we first started on this work up there, we were told

and we read that it was necessary to have a high current density, but our actual experience has shown us that it isn't any more necessary to have a high current on die castings than it is on any other metal. But you should have a solution more rich in metal than used for the average stuff like iron, steel or brass, and you should have a good contact. We find it very necessary. There are times (it doesn't often happen, but it used to) we find we will get a piece out of a batch that is a dark brown all over. And, of course, the men doing the plating have learned that their contact is poor somewhere, and the first thing they do, of course, they will look at their work rod and, as a rule, will find that it has been contaminated with the nickel solution dropping on, and they are not getting the proper contact. That is the cause of a lot of trouble in plating this stuff—not having a good, steady flow of current, and good contact with the work on your work hooks or wires, whatever you might use. We, in our work up there, mostly use hooks. We find we get better results and can handle more work. I would say that last year we handled one job which ran pretty close to a quarter of a million pieces, and it wasn't necessarily a small job, either; it wasn't large. It was a radiator cap for an automobile and, among other things, was an Oakes lock. We have some here tonight—possibly 80,000 or 100,000 pieces of those things, and in all those pieces we have done very well without the use of instruments for measuring, which I don't doubt we should have.

But I believe I am thoroughly in sympathy with an article I read in your pamphlet that was given to me which said that every plating should be equipped with whatever instruments are necessary to guide the plater and let him know where he is going. As I said before, we know where we are going only because of our experience. We have had to do it, that is all. We had to get it without the use of instruments because we didn't have them; we didn't know they were made at the time for that purpose. Possibly they weren't; I don't know.

Speaking of current density, I would say that two volts is about the average that we use up there. Now, somebody might say, "How many amperes do you use?" and all that. I don't know. We don't have an ammeter. We never had one, and if we got one in we would have to start and experiment with it to find out how many amperes were necessary on the various kinds of work. But, as it is now, we go along and do it on the voltage alone, depending on our experience of the past.

I guess that is about all I can say. As I said to Bill Scott, I thought I could tell all I knew in about five minutes. Oh, yes, I don't want to forget the anodes. The anode surface. There was one of the things that we were always told there had to be a certain proportion of anode surface to a certain proportion of cathode surface. We don't find it that way. It doesn't make any difference whether we plate one of these things I have here or twenty-five of them; we have the same anode surface just the same, and we get the results. The only thing is, if we have one piece we have to protect it with a couple of buffers; that is all. But we find that by using about all the anodes we can crowd into the tank conveniently, we get the best results.

We haven't used, I am safe in saying, one hundred pounds of nickel salts in a year and a half. I don't think we have put in ten pounds of nickel salts in the past six months in our solution. We feed it entirely from the anodes, and in connection with that, I would say the anodes must have been fairly good. I don't know if there is anything else I could say along that line. Possibly if I had a few questions which I would be able to answer I might think of some more.

Question: You say you use two volts on your plating; what voltage do you use on your cleaning?

Mr. McLatchie: We use all we can give it. We haven't any voltmeter on the cleaning tank. I would say that the capacity of our generator is about six volts, and that is about what we use on our cleaner.

Question: We have noticed on the radiator caps, especially I have noticed it the last few months, the different styles. There are some with wing-shaped radiator cap, plated along back. There are probably two or three instances where you have got to throw inner. Have you had anything like that?

Mr. McLatchie: We have had a number, not of those radiator caps, but we have had a number of pieces similar to that, and while I believe that deep impressions are pretty hard to reach, if the opening is large enough I believe that it can be covered with the solution we use now.

Question: You are plating wing caps now, aren't you?

Mr. McLatchie: Yes, but the wings run off at an angle, the cap you speak of.

Question: How long do you leave it in the tank?

Mr. McLatchie: Depending on the size of the work. I have

a piece of work here. (Shows.) It is a cowl light bracket for the new Durant car, which, I believe, is coming out next year, and we give that about twenty minutes at two volts, and our solution will stand about ten or twelve. Of course, that doesn't mean very much after you work the solution for a while, when you get a lot of different ingredients in there. That doesn't tell you very much about your metal content, but I would say the metal content of the solution should be close to three ounces to the gallon.

Question: Do you use single salts or double?

Mr. McLatchie: Single.

Question: And how much sulphate of soda do you use?

Mr. McLatchie: Ten to twelve ounces to the gallon. We have never used sodium citrate. I suppose it gives results some places, but we use sodium sulphate for the reason, in the first place, it is cheaper, and you can have it on hand in bulk; it is very easily dissolved; the fact is, if necessary, we can put it in at noontime and go right along working. It doesn't interfere with our plating at all.

Question: How do you control your sodium sulphate content?

Mr. McLatchie: Only by observation, that is all.

Question: What is that observation? How do you know when to put it in?

Mr. McLatchie: Our experience with our work will show us when it is coming out of the tank whether or not it is a good plate. In the old days, it was the only method. You looked at your work when it came out of the tank, and you decided whether or not you were getting a good plate. You wouldn't have much trouble in deciding on die castings. It is either good or it isn't.

Question: That is what I wanted to get at.

Mr. McLatchie: When your sodium runs low, your work will begin to streak, and I would imagine from that your acid is getting too strong in your solution. The addition of your single salts, of course, is giving you more acid all the time.

Question: In other words, when you notice the streaks, you add sodium sulphate?

Mr. McLatchie: Yes. It doesn't always mean that, that is the only way in which you might have a failure in your work. If you have your work hanging in your cleaning solution too long and take it out and put it through the ordinary procedure, and put it into your nickel solution, you will find, especially on the

edges that are mostly exposed, it will be a very dark color. It doesn't take at all; doesn't plate at all. It seems to me that the alkali in your cleaning solution attacks the base metal and I would say it dissolves it, and, of course, there is a coating over it there at that particular spot, and the nickel won't adhere at all.

Question: On your cleaning solution, what do you use for that?

Mr. McLatchie: Wyandotte.

Question: Do you use a reverse current?

Mr. McLatchie: No, we used to use the tank as an anode, but we don't any more because we had too much trouble keeping it clean. The solution and the zinc in these castings will adhere to the sides of the tank and put a scum over it which will insulate it, so we now use a regular steel anode; but even then you will find at times your work isn't cleaning properly, and when we find that condition we take our anodes out and run them over a steel wire brush wheel and clean them thoroughly.

Question: If you have two concerns you are buying your buffing compound from, both first-class concerns with good, first-class material, would they both work in the cleaner the same way?

Mr. McLatchie: They should. The object of your cleaner is to dissolve. The composition of the cleaning compounds, I would say, taking them at the same price, I don't see that there could be very much difference in the compound. The trouble you might have with your cleaning if they used some kind of a binder in there which wouldn't dissolve, wouldn't emulsify. Then you might have trouble, but then you wouldn't be getting the same grade of polishing compound if that were the case.

Question: How long do you have to strike in your cleaner?

Mr. McLatchie: We leave it in there, I will say, about on an average of three or four seconds.

Question: In other words, you just simply rub it across the rod and take it out?

Mr. McLatchie: Yes. Here is the way they work as a rule. We have only got a couple of tanks, and they will put about one-fourth of the capacity of the tank in the cleaner, and when that is cleaned, they will hang it into the nickel solution and turn on their current, protect the end pieces, of course, and they will do that until their tank is full, and from that on they will work it all day long in whatever number of one, two, three tanks, whatever they are using. It is a continuous thing.

Question: You don't need much soaking in your cleaner, then?

Mr. McLatchie: No. The polisher can help a lot by keeping the casting clean. I have three or four here that I will pass around. (Gives out castings.)

Those are ground on a 150-grain emery, but these castings are run right over the buff. The reason, as I said before, is that casting, being a large one, is somewhat rough on the surface, and must be ground to get down to a good base.

Question: Do you ever get castings with high aluminum content?

Mr. McLatchie: We never really bother much about what is in them. When you consider we are doing plating for what they claim to be the largest die casting plant in the world, the Doler Die Casting Company, and their zinc base metal is made mostly in their Pottstown plant—that doesn't mean we are plating all the work they do, because there are any number of plants which do their own plating, but all the work they get with the request for nickel plating, we get, and it is quite a bit of work when you consider that it is polished and plated a good deal quicker than iron, brass or steel. You can readily see that a plant with even four or five polishers can handle quite an amount of stuff in a year.

Question: Do you put anything else in that nickel solution—ammonium chloride or boric acid?

Mr. McLatchie: Oh, yes. As I said here before, the regular nickel solution, as I take it, will be made up of 12 or 14, or whatever the case might be, ounces of single salts, and two ounces of boric acid, two ounces of sal ammoniac, and the sodium sulphate.

I really believe most trouble in plating die castings is caused not by ignorance of the plater or his lack of materials, but I believe it is due to the fact that they try to plate die castings in with other work. And it is a pretty hard matter for this reason. You might plate it in your nickel all right, if you can clean it, but a cleaner that would clean iron, brass or steel, would ruin that stuff in less time than we would leave it in there to clean. And I think a lot of trouble in plating die castings is due to the fact they try to plate it in with other work. I don't think that anybody would have very much trouble plating die castings if they had a solution for die castings and a cleaner for the same.

Question: On your buffing compound, would you use the

same buffing compound for die castings as you would for brass?

Mr. McLatchie: Yes, just the same.

Question: In the temperature of the cleaner, has that any tendency to open up the pores of your metal when it gets too hot?

Mr. McLatchie: There are times when you get castings that have cold cuts in them. They have a hair line streak through them. It may be that the casting isn't properly knit in the die. As I understand it, the die is cold, and the casting doesn't knit properly, and if that is the case, we have found where we have had castings where, when we put them in our cleaner, naturally they expand and they open up. When they do that, unless you take them out and grind them and get below that surface, you are going to have a poor job. We haven't had much trouble, but since you mentioned that, I remember having one job, a pretty good sized job, too, where they had to take the castings and remelt them. We couldn't do anything with them.

Question: Did you ever see any of this work after it was out for six months or a year?

Mr. McLatchie: I have had work up there on automobiles two years and have been watching it to see what the result would be. Now I find, of course, if they don't rub it up occasionally, it will get dull, just as any other nickel plating will do, but if it is rubbed up occasionally just with a dry rag, they will have a good job, I will say, for two years. I say two years because that is about the length of time I have been watching some of our work up there.

Question: Does any of it blister after being out that length of time?

Mr. McLatchie: Not to my knowledge; I have had no knowledge of it. I haven't had any complaints along that line. If it does, it has never gotten back to us.

Question: Have you observed what effect salt air has on it—that is, along the seashore, places of that kind? How does that affect it?

Mr. McLatchie: No, I haven't, but I imagine it would be pretty hard on it.

DETROIT BRANCH

Detroit Branch, A. E. S., held its regular meeting Wednesday, August 8, at the Hotel Statler, President E. V. Allen presiding. The night being a hot one, the hotel management donated the ice water. It was unanimously decided that after the warm days of June, July

and August to continue the educational sessions, which have proven so successful. These meetings are held in alternate months and are addressed by some prominent speaker on subjects of interest to our craft.

Our Question Box is meeting approval of all our members, as it tends to create more of a brotherly interest in one another. Our first question is:

Why is it necessary to copper plate and copper buff steel that is to be chrome plated?

Ans.—It is not necessary, but due to the polishing cost in obtaining the desired lustre it is the most economical.

Ques. 2—Does it hurt a chromium solution to strip copper off steel.

Ans.—It is not advisable.

Ques. 3—What effect does the boracic acid concentration have on salt spray? What is the maximum limit allowable in nickel?

Ans.—To this question we ask for an answer in the Review.

Respectfully yours,

Chas. M. Phillips, Secretary-Treasurer,
13421 Camden Ave.

TORONTO BRANCH

The regular meeting of the Toronto Branch was held on the evening of July 23 at the Canadian Forester's Hall, 22 College St.

This being the first meeting held since Convention, we had a very good attendance in spite of the hot weather.

Mr. J. Acheson, chairman of the Convention Committee, gave a report of progress which was pleasing to the members of the Toronto Branch. The efficient manner in which the Convention Committee carried out everything to a successful conclusion. On account of minor details, the committee will continue for a short time before being dismissed.

It was decided by the members to hold our next meeting on the fourth Monday evening in September, when all will return to a new start, prepared for busy months to follow. Adjournment, 10:30.

W. J. Sutherland, Secretary-Treasurer.

NEWARK BRANCH

Our July 6th meeting was attended by 21 members, and was opened by President Geo. J. Wagner. Due to the absence of the Secretary, Royal F. Clark, who is confined to his home with inflammatory rheumatism, Mr. George Reuter was appointed Secretary pro-tem. One application was received and one applicant acted upon and elected.

Mr. Horace Smith, our newly-elected Supreme President, gave a splendid talk on the Convention, thanking the delegates for the honor. Mr. Smith suggested that the members of Newark Branch form a club and contribute a small amount each month to enable them to go to the next convention at Detroit. Mr. Sizelove spoke on the educational features of the convention. Chromium was discussed with the usual vigor.

On Friday, July 20, President Geo. J. Wagner opened the meeting with 22 members present. Four applications were received and ordered to take the usual course. Mr. Sizelove spoke on the forthcoming fishing trip.

The meeting was turned over to the Librarian, Mr. S. R. Taylor, who brought up for discussion, "The Rose Gold Solution," and brought out some very interesting points. The comparative cost of nickel and chromium plating was discussed. Meeting adjourned at 9:55 p. m. George Reuter, Secretary Pro-tem.

PHILADELPHIA BRANCH

The July meeting of Philadelphia Branch was held on the evening of the 13th, with President Gehling in the chair and a good attendance. As the speaker of the evening we had the pleasure of hearing Dr. H. S. Lukens give his practical experience in three months' study of a 300-gal. chromium solution as recommended by the Bureau of Standards.

Showing on the blackboard the changes taking place during this study, Dr. Lukens handled his subject in a very thorough manner and at the conclusion was given the usual rising vote of thanks.

A. T. Lunbeck read the report of the convention proceedings. The report was received and filed.

There will be no meeting in August.

PITTSBURGH BRANCH

Regular monthly meeting held in the downtown branch Y. M. C. A., Wednesday evening, August 1, with a fair attendance. Our delegates to the convention, which was held in Toronto, Ont., made their report, and they gave a good account of the doings, and stated that every one had a most enjoyable time. We had our program outlined for the year 1928-1929, which was adopted and ordered printed. After some discussion, the members decided to hold our meetings in the future on Friday evening, so starting with our September meeting and thereafter, all meetings will be held on the first Friday evening of each month. These meetings will be of interest to every member who should make every effort to be on hand. As the night was very warm, those present desired to get away, and meeting adjourned at 10:30 p. m. until Friday evening, September 7, at which time our guest speaker will be Mr. Clarence Van Dereau, of Mansfield, Ohio, who will talk upon Chromium, and should be of interest to all wide-awake platers. S. E. Hedden, Secretary-Treasurer.

BALTIMORE-WASHINGTON BRANCH

A meeting was held July 14, 1928, in the Chemistry Building, Bureau of Standards, Washington, D. C. Mr. F. F. Pierdon, Chairman; Mr. Geo. F. P. Turner, Secretary.

Dr. Blum took the members through the building and explained the work of each department, after which he gave us a talk on "Chromium, Its Advantages Over Nickel, Its Hardness and Resistance

to Tarnish." Samples were passed around for inspection. It was a very interesting talk. Anybody wishing to obtain a copy on the Electro Deposition of Chromium can do so by writing to the Government Printing Office for the Bureau of Standards Technologic Paper No. 346. The cost of which is 15 cents.

A standing vote of thanks was given Dr. Blum for his talk.

Mr. Barrows will be speaker at our next meeting August 4, 1928. Subject, "Spotting Out." Also election of officers next meeting.

Twenty-nine attended meeting and ten applied for membership.

Geo. F. P. Turner, Secretary.

BALTIMORE-WASHINGTON BRANCH

The above Branch held another meeting in the Chemistry Building, Bureau of Standards, Washington, D. C., August 4, 1928. Mr. F. F. Pierdon, Chairman; Mr. Geo. F. P. Turner, Secretary.

Business for the evening was election of officers and talk on "Spotting Out" by Mr. Barrows. The following officers were elected:

President, Mr. F. F. Pierdon; Vice-President, Mr. M. J. Kraft; Secretary-Treasurer, Mr. Geo. F. P. Turner; Librarian, Dr. Blum; Board of Managers, Mr. T. F. Slattery, Mr. H. J. Heller, Mr. Wm. Gibson.

After which we had Mr. Barrows give us a talk on "Spotting Out," showing us samples of builders' hardware oxidized, finished and lacquered; also cast metals explaining to us the causes of this spotting out and stain spots; also what was being done to stop these faults. His talk was very instructive to us all and a standing vote of thanks was given Mr. Barrows for his talk.

Sixteen members attended meeting. We certainly expected more, but perhaps the very hot weather kept the attendance down.

Our next meeting will be held in Baltimore September 8, 1928, at a place to be given later.

We expect a good crowd present, so all members please take notice and attend these meetings as they are strictly for the benefit and education of all interested in the electro deposition and coloring of metals.

Geo. F. P. Turner, Secretary.

ROCHESTER BRANCH

Rochester Branch held a very interesting meeting at Powers Hotel July 20. President Reama being on his vacation, the meeting was called to order by Vice-President Hart.

Mr. Leeman Leighton of Ogdensburg, N. Y., and Mr. Bror. Eliasson of Niagara Falls were accepted as members.

Mr. Fields, Gartland and Lopez, gave a very interesting report of the Toronto convention which was enjoyed by all.

Rochester Branch will hold their annual outing and clam bake early in September and the Secretary was instructed to get all Rochester members out to the August meeting so final arrangements to put the outing over could be arranged. Adjourned.

Charles Griffin, Secretary.

CHICAGO BRANCH

Chicago Branch held its regular monthly meeting August 11 at the Atlantic Hotel.

Meeting called to order at 8:15, President Robt. Meyers presiding.

There was a good attendance as we had the honor of having Dr. Blum as our ever welcome visitor.

The members not attending missed a treat as every member knows that when Dr. Blum is at the meeting they can always go away with a great deal of knowledge which is always helpful to the plater.

Dr. Blum's message to the members was "Chromium Plating and the Danger to the Workman in Plating Rooms Where Chromium Plating Is Done."

Chicago Branch would like to publish Dr. Blum's talk, but as he said so many things it would be almost impossible, but we would like to have men of Dr. Blum's caliber as our guides then we feel we would be far more advanced in the art of plating.

Chicago Branch wants to thank Dr. Blum for his visit and hopes to again have him as our visitor in the near future.

The general order of business being completed our Librarian being absent, President Meyers asked F. J. (Dad) Liscomb to act as Librarian. Between Dr. Blum and Dad the question box was well taken care of.

Ques. 1—Will nickel deposit absorb chromium the same as zinc does copper?

Ans. 1—It has not been determined.

Ques. 2—Under what proportion of cyanide contents, metal contents and current pressure will a cadmium solution give the best throwing power?

Ans. 2—6 to 7 oz. free cyanide 10 to 15 amp. per square foot.

Ques. 3—What is a good oxidize on cadmium gray black color desired?

Ans. 3—Arsenic added to copper solution can be used with current or as a dip in water 1 gal., ammonia 1 pt., molydic acid 1 lb.

Ques. 4—What method should be used in plating steel studs with screw slots in head to stand 48 hours salt spray these parts to be finished in chromium?

Ans. 4—Depends entirely on copper or nickel deposit.

Ques. 5—How is the P. H. of chromium solution determined what is it relation to sulphate contents?

Ans. 5—The P. H. of the chromium solution is of very little importance as the P. H. will be 1 or more, sulphate should be about 1 or to 1.

Ques. 6—What causes brass to tarnish besides dampness?

Ans. 6—It was thought it was caused from the lack of metal in solution or light deposit and can come from humidity in room causing spotting out.

There being no further business meeting adjourned 10:30 p. m.

S. J. C. Trapp, Secretary.

APPLICATIONS

	Branch
August A. Miller, 306 Geyer Ave., St. Louis, Mo.	St. Louis
George W. Gillson, 411 E. 18th St., Kansas City, Mo.	St. Louis
Leo J. Schmitt	Pittsburgh
Daniel Davis, 848 Devon St., Kearney, N. J.	Newark
Paul A. Olden, 143 Schuyler Ave., Kearney, N. J.	Newark
Wm. C. Treadwell, 9 Riggs Place, West Orange, N. J.	Newark
R. Frank Weaver, 718 Highland Ave., Newark, N. J.	Newark
M. G. Herback, 1727 Howard St., Philadelphia, Pa.	Philadelphia
John Miller, 620 6th Ave., Bethlehem, Pa.	Philadelphia
W. Raymond Good, R. D. No. 2, Royersford, Pa.	Philadelphia
August Dudley Weil, 3-4 Hardwick St., London, Eng.	Philadelphia
Stanley F. Town, 23 Turner St., Merritton, Ont., Can.	Toronto
Arthur W. Johnson, 318 Ashland Ave., London, Ont., Can.	Toronto

ELECTIONS

	Branch
Alfred J. Penman, 3315 W. 105th St., Cleveland, Ohio.	Cleveland
Leeman Leighton, 817 Ford St., Ogdensburg, N. Y.	Rochester
Samuel J. Pearce, Box 876, Port Hope, Ont., Canada.	Toronto
Albert E. Fryer, 90 Helena Ave., Toronto, Can.	Toronto
Bror. Elliasson, % Wm. A. Rogers, Ltd., Niagara Falls, N. Y.	Rochester
Chas. H. Eldridge, 302 Piper Blvd., Detroit, Mich.	Detroit
Wendle P. Barrows, % Bureau of Stand., Washington, D. C.	Baltimore-Washington
H. J. Heller, 309 13½ St. N. W., Washington, D. C.	Baltimore-Washington
Armand Tschante, 3318 P. Street N. W., Washington, D. C.	Baltimore-Washington

RESIGNATIONS

	Branch
Joseph T. Payne, 21 Walnut St., Hamilton, Ont., Can.	Toronto

SUSPENSIONS

	Branch
Chas. C. Ney	Bridgeport
N. S. Lavoie	Bridgeport
John F. Courtney	Bridgeport
Ed. V. Andrew	Bridgeport
Carl W. Everey	Detroit
Jos. McCluskey	Detroit
Wm. J. Lamb	Detroit
August A. Spies	Detroit
Jacob Liebman	Philadelphia
Louis Sherman	Philadelphia

BOSTON

Platers' Supply Co., 202 Friend St., Boston. Secretary, A. W. Garrett, 41 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Friday of each month at 62 Cannon St., Room 17, Bridgeport, Conn. Secretary, Wm. Ehrencrona, 872 Hancock Ave., Bridgeport, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St. Secretary, S. J. C. Trapp, 1127 N. 7th St., Maywood, Ill.

CINCINNATI

Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty St. Secretary, Al. Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton. H. Terdoest, 414 Pioneer Ave., Akron, Ohio.

HARTFORD-CONN. VALLEY

Meets fourth Monday in each month alternately at 266 Pearl St., Hartford, Conn., and corner Broadway and Worthington St., Springfield. Secretary, Grant Vernon, 43 Putnam St., Bristol, Conn.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Robert G. Suman, 2734 Ridge Road, Dayton, Ohio.

DETROIT

Meets the second Wednesday of each month at the Detroit Testing Laboratory, 554 Bagley Ave., Detroit. Secretary, Chas. Phillips, 13421 Camden Ave., Detroit, Mich.

GRAND RAPIDS

Meets on the second Saturday of each month at the Vocational High School, 129 Bostwick Ave., N. E. Secretary, Jacob Van Dyke, 1361 Union Ave., N. E., Grand Rapids, Mich.

INDIANAPOLIS

Meets the second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

MILWAUKEE

Meets second and fourth Thursdays of each month at Cor. 3rd St. and Highland Ave. J. N. Hock, 1229 W. 24th St., Milwaukee, Wis.

MONTREAL

Meets last Friday of month at Office of Secretary, John H. Feelay, 411 Aylmer St., Quebec, Canada.

NEWARK

Meets first and third Fridays of each month at Franklin Hall, 41 Franklin St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Royal F. Clark, P. O. Box 201, Newark, N. J.

NEW YORK

Meets every second and fourth Fridays of each month in the World Building, Park Row, New York City, N. Y. Secretary, R. J. Liquori, 2439 Hubbard St., Brooklyn, N. Y.

PHILADELPHIA

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, P. Uhl, 2432 North 29th St., Philadelphia, Pa.

PITTSBURGH

Meets first Friday of each month at 8 p. m., at downtown branch, Y. M. C. A. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third Thursday of each month at 44 Washington St., Prov. Engineers Rooms, Providence, R. I. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets every third Friday of each month at the Powers Hotel. Secretary Chas. Griffin, 24 Garson Ave., Rochester, N. Y.

ST. LOUIS

Meets first Friday of each month at Barr Branch Library, corner Jefferso and Lafayette Sts. Secretary, C. T. McGinley, 5312 West Florisant Ave., St Louis, Mo.

TOLEDO

Meets first Thursday of each month at Toledo Secor Hotel, corner Cherry an Page Sts. Secretary, W. W. Weiker, 2228 Middlesex Rd., Route 2, Box 635, Toledo, Ohio.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, W. J. Sutherland, 197 Gillard Ave., Toronto, 6, Canada.

WATERBURY

Meets every second and fourth Thursday of each month. Secretary, Wm. F. Guilfoile, Garden Theatre Bldg., East Main St., Waterbury, Conn.